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J. E. WICKHAM

*File
Coal Strength*

Date: April 17, 1985

To: • P. Martin

From: • D. McRae and R. Newman

Subject: • Relative Density Measurements of Experimental Cigarettes using Neutron Radiography.

The real-time neutron radiography system was used to measure the relative densities of cigarettes from three sets of experimental and commercial cigarettes. The cigarette types were: 25 pack of Marlboro 85 mm cigarettes with increased packing density at both ends of the tobacco rod (double dense ends); 25 pack of experimental Marlboro 85 mm cigarettes with increased packing density only at the lighting end of the tobacco rod (single dense end); and 20 pack flip top box of Winston cigarettes. Twenty cigarettes were chosen from each sample for measurement. The real-time neutron radiography system creates a video image of the cigarettes using a collimated beam of neutrons and a neutron camera. The video image is then analyzed with an image processor to obtain the luminances of the individual picture elements (pixels) along the centerline of the cigarette. The luminance values for the cigarette are converted to relative density values using Beer's law with the luminance values for the video image without the cigarette in place. It should be emphasized that the density measurement is only for a line approximately 0.4 mm wide along the centerline of the cigarette image.

Figure 1 shows the relative density for the double dense ends Marlboro cigarettes averaged over 20 cigarettes. The tobacco rod and the filter regions are labelled on the figure. The dense ends are clearly evident as regions of higher density at both ends of the tobacco rod. Figure 2 presents the results for the single dense end cigarettes also averaged for 20 cigarettes. The increased density at the lighting end is apparent but, more importantly, the filter end of the tobacco rod does not show an increase in density. Figure 3 shows the density plot for the Winston box cigarettes averaged for 20 cigarettes. The dense ends of the Winstons are quite extreme when compared to the Marlboro cigarettes.

For comparison, several density plots from individual cigarettes are shown in Figures 4 through 7. The first thing to notice is that the variation in the density along the centerline of an individual cigarettes is quite large. While we have not completed our analysis of the density measurement technique, we are reasonably certain that these variations are real. An indication of the actual statistical noise in the density plots can be seen in the filter regions of the cigarettes where the density is known to be reasonably uniform. Figure 5 is of interest because it shows the density trace of a cigarette that had a visible gap between the tobacco rod and the filter. The gap is indicated by a drop in the density at the rod-filter union.

McRae

R. Newman

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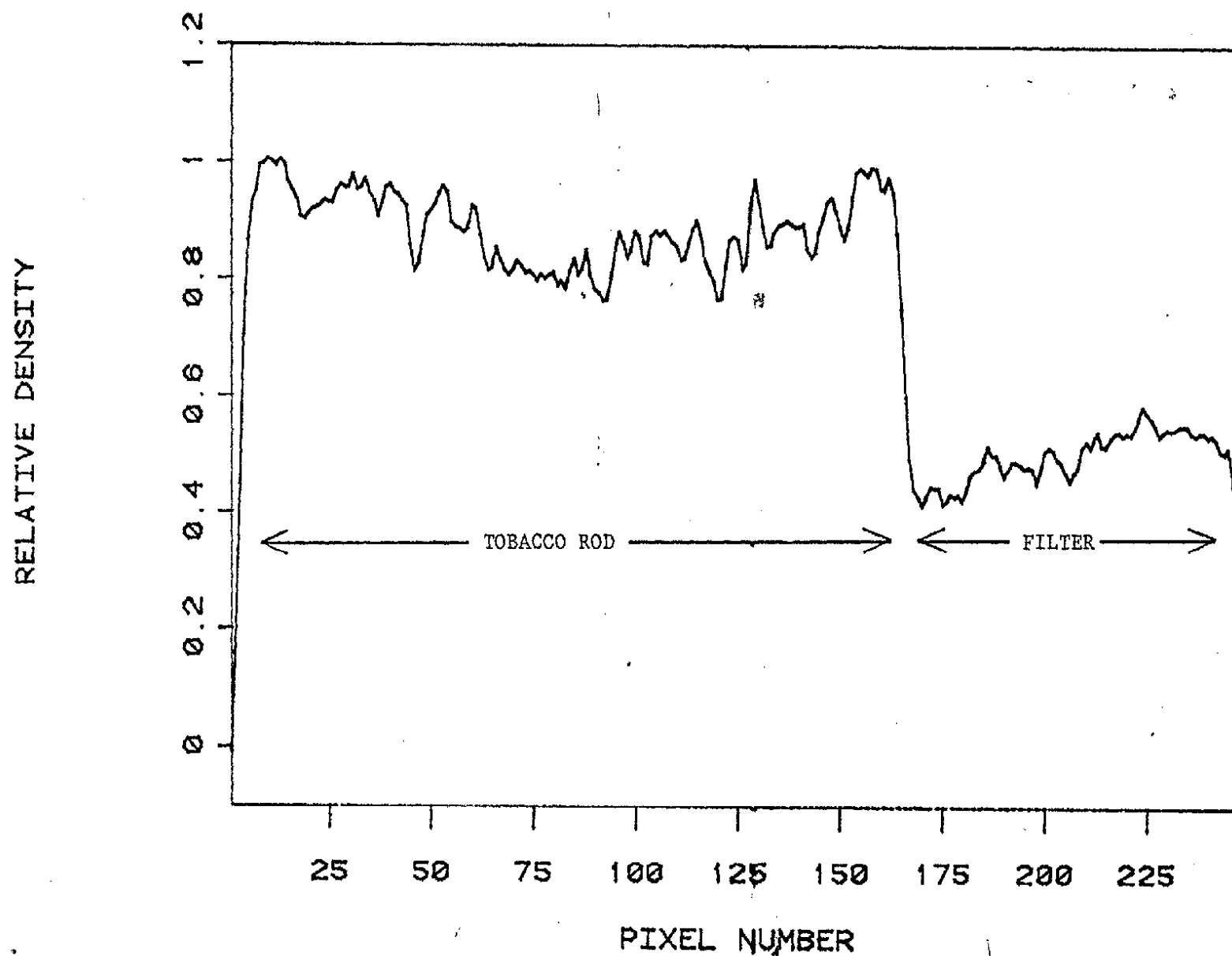
cc:

M. Anderson
J. Crichton
M. Evans
D. Fox
C. Irving
R. Jenkins
W. Kuhn
C. Lilly
T. Newman
N. Nunnally
F. Sherwood
S. Southard
J. Stargardt
E. Wickham

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FIGURE 1

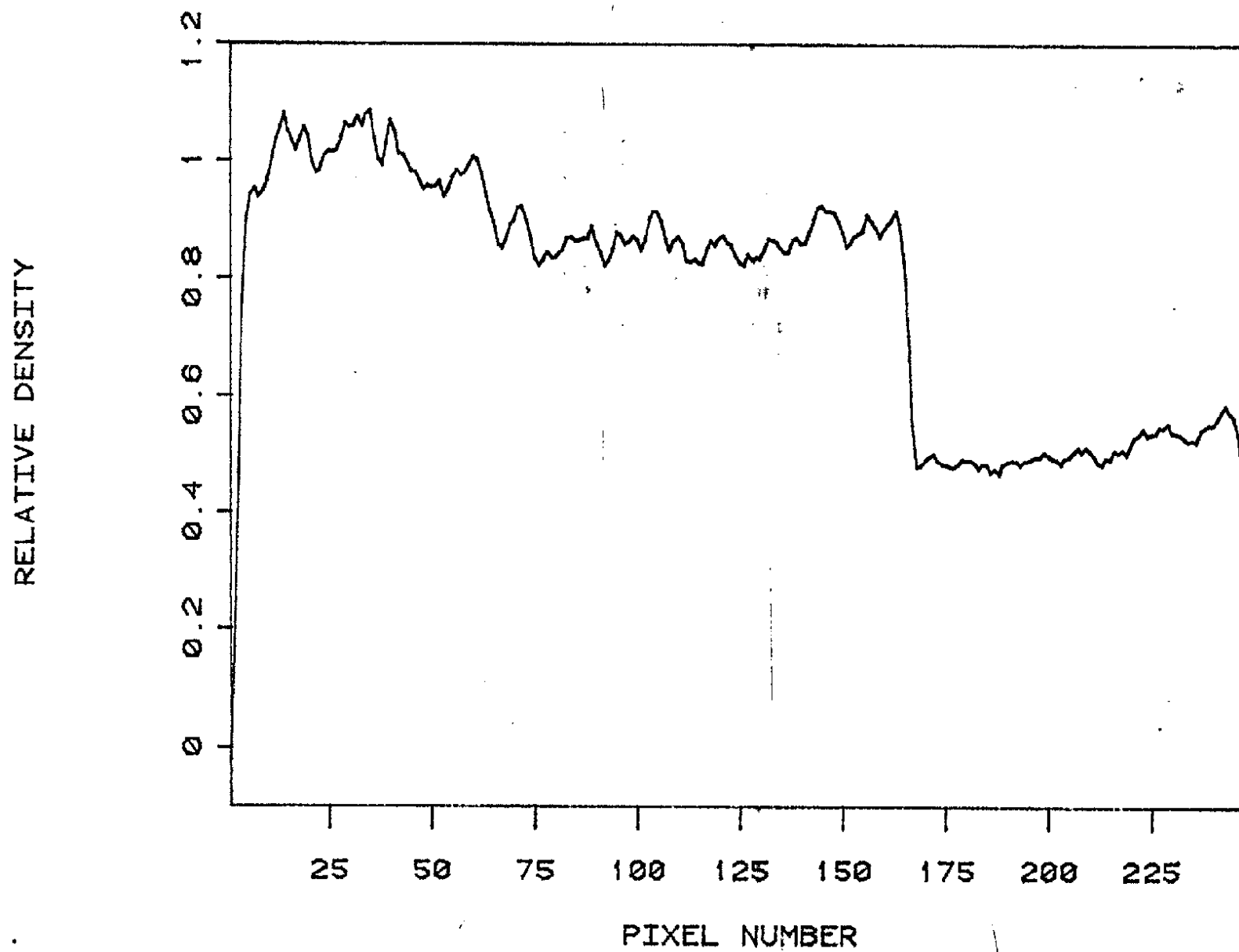
DOUBLE DENSE ENDS



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FIGURE 2

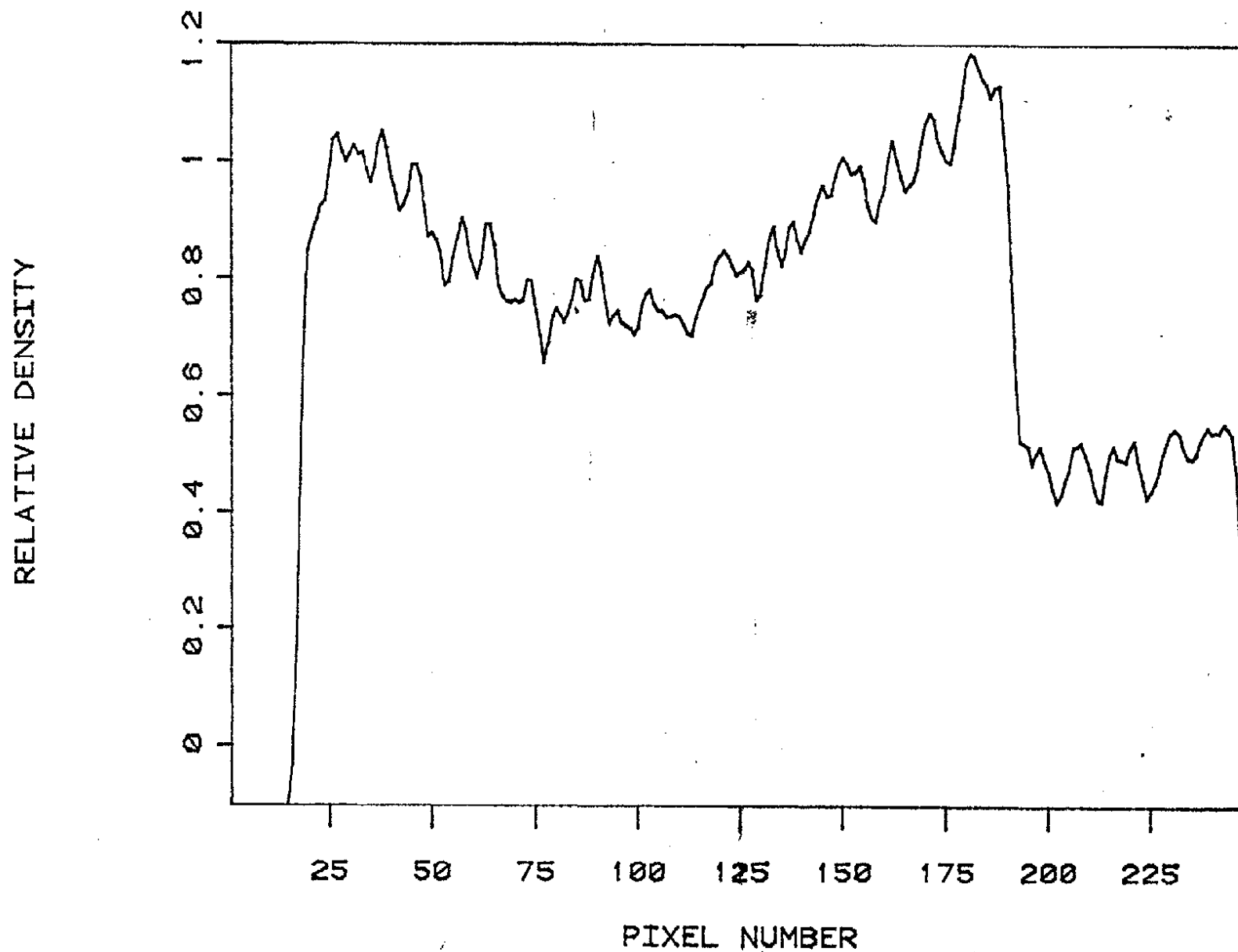
SINGLE DENSE END



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FIGURE 3

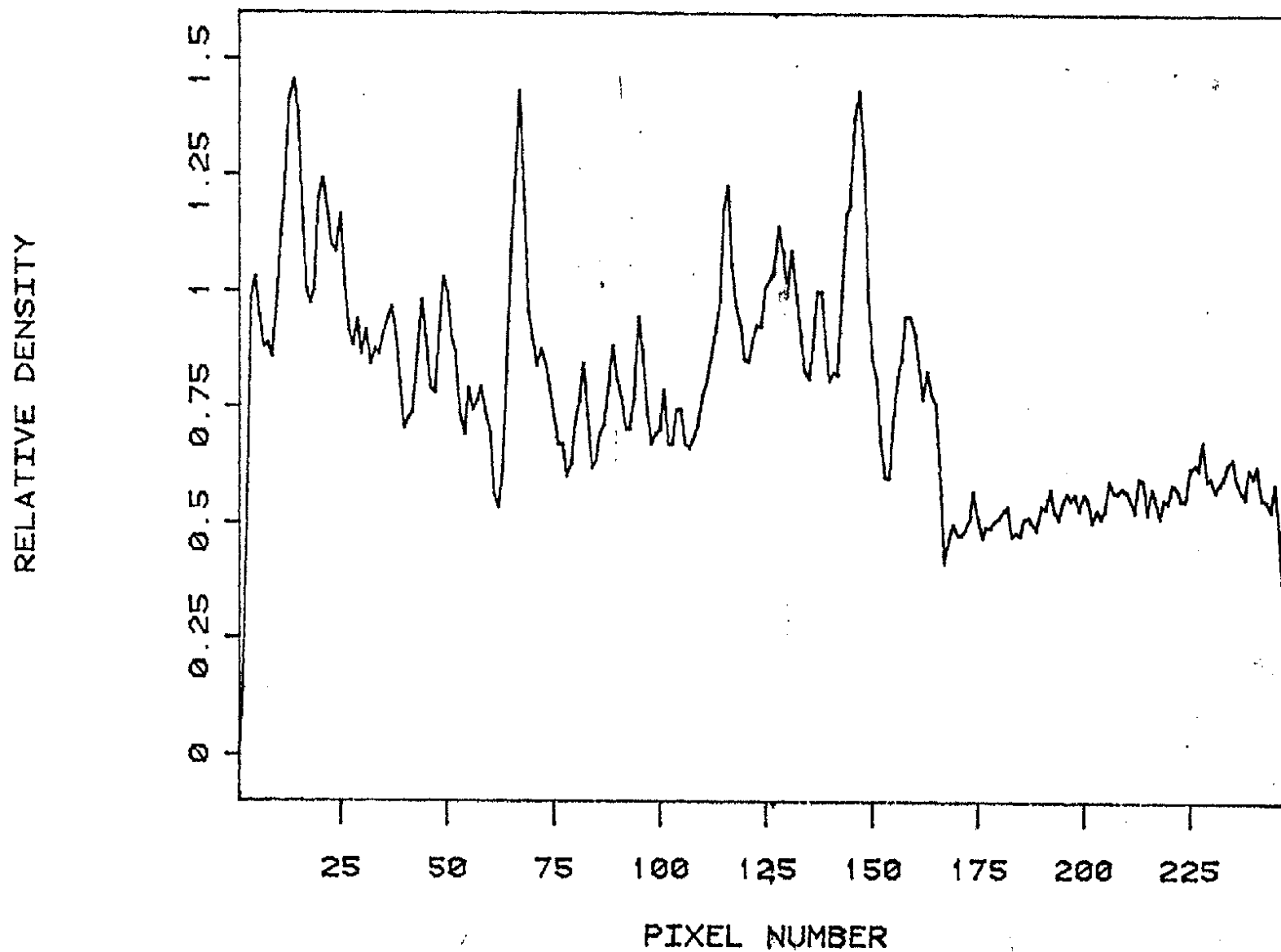
WINSTON BOX



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FIGURE 4

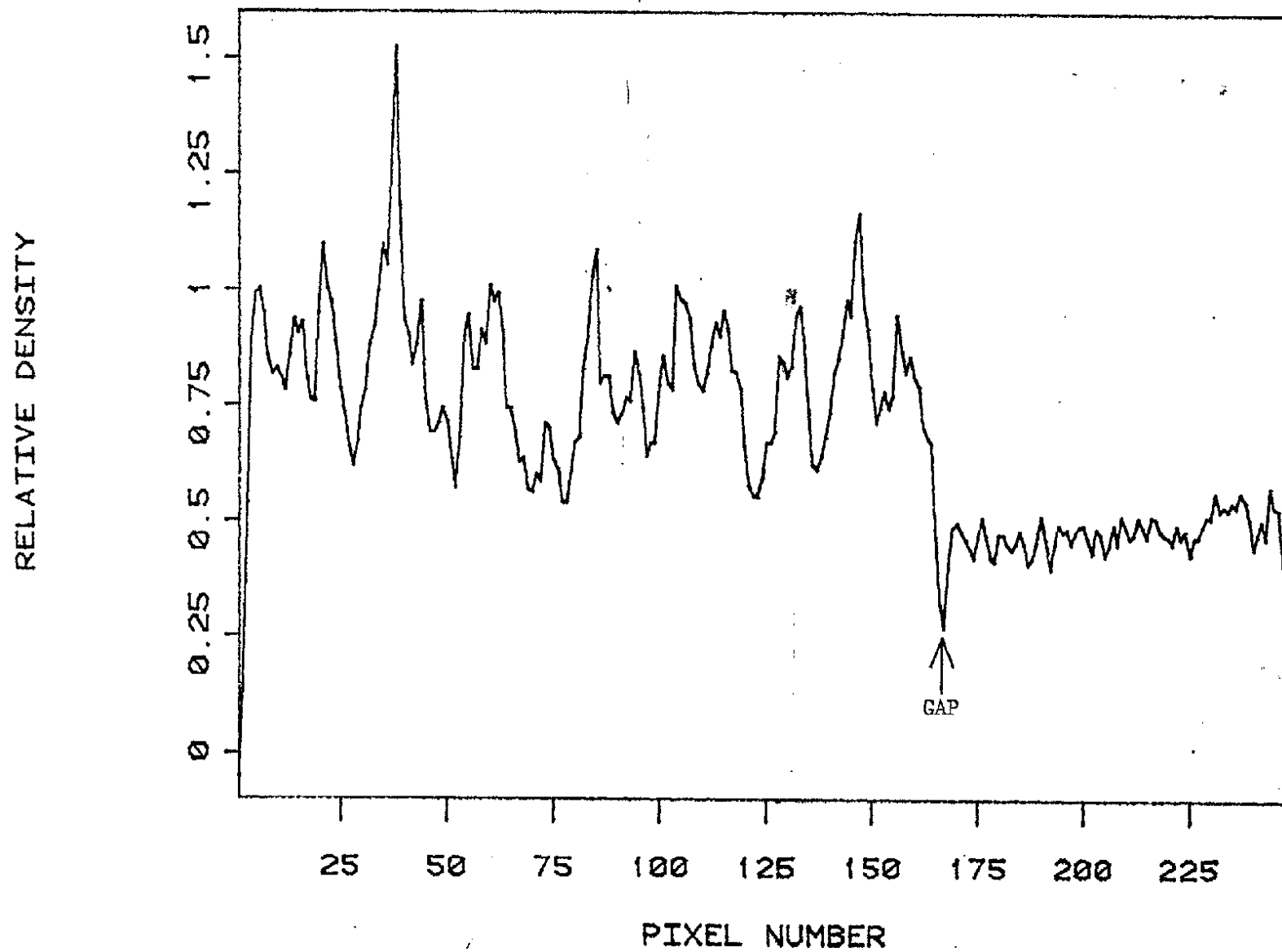
CIG. NO. 1 DOUBLE DENSE ENDS



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FIGURE 5

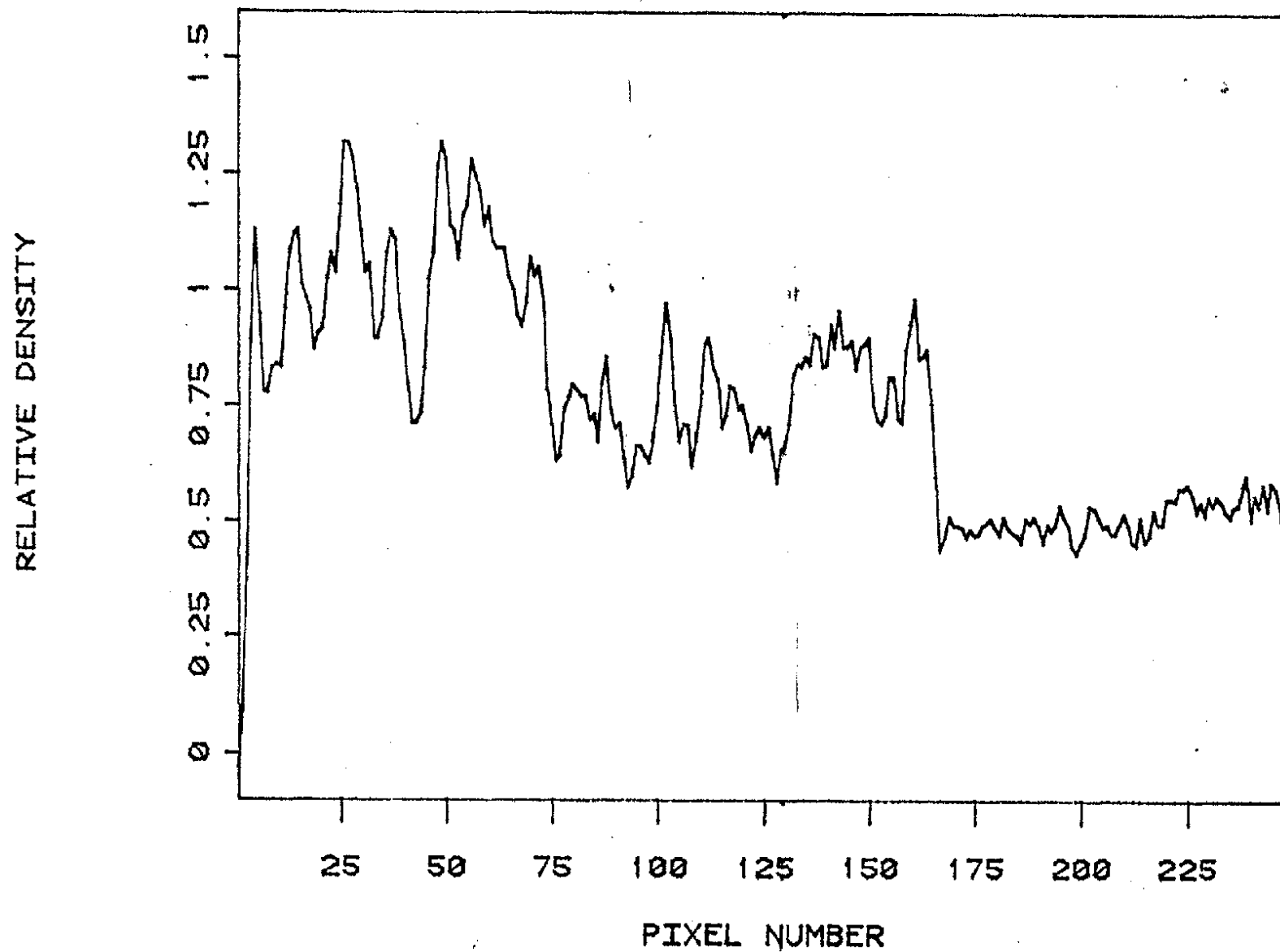
CIG. NO. 4 DOUBLE DENSE ENDS



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FIGURE 6

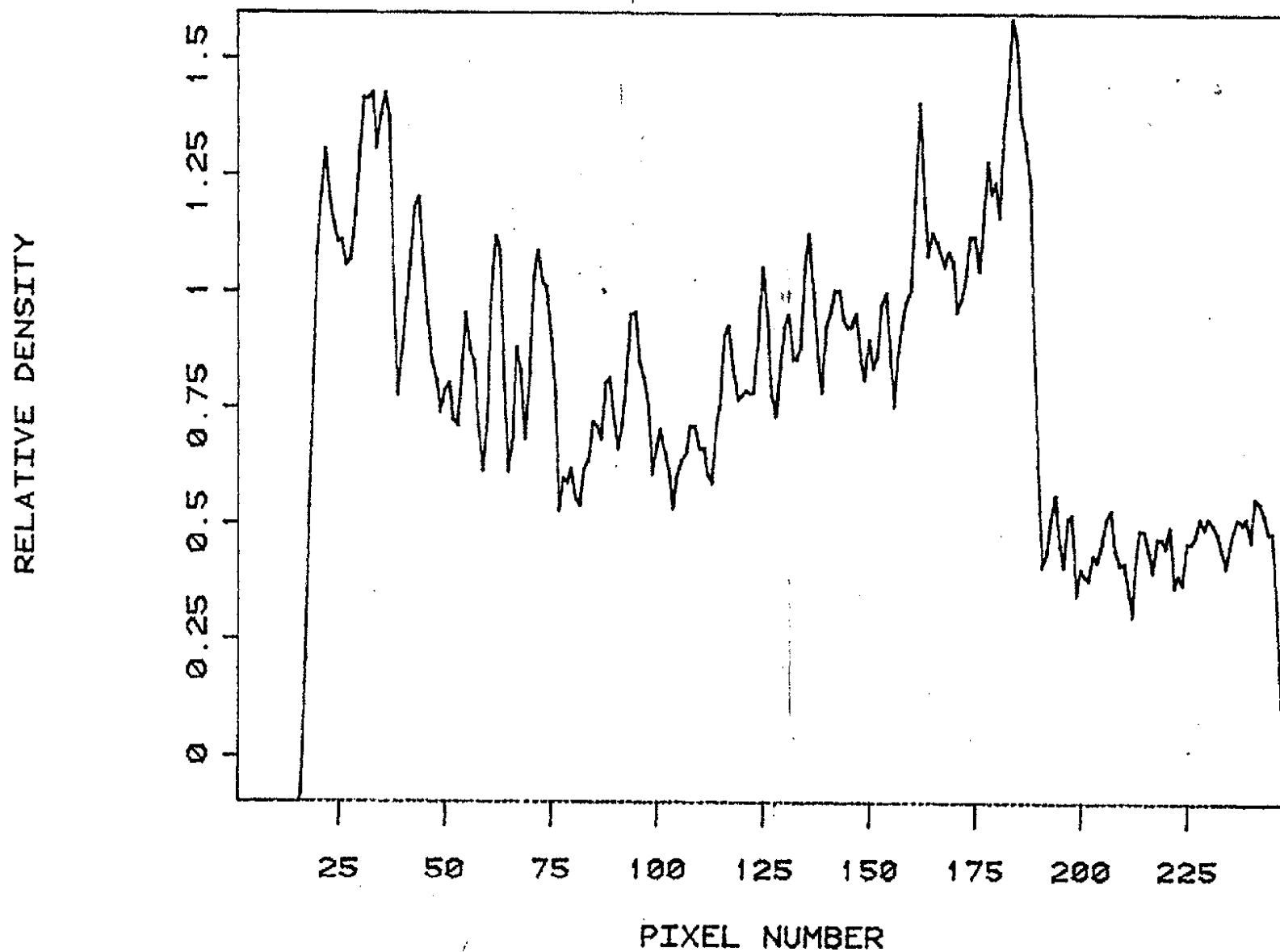
CIG. NO. 1 SINGLE DENSE END



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FIGURE 7

CIG. NO. 1 WINSTON BOX



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